

PULSE GENERATOR

MODEL 738

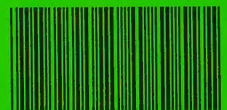
INSTRUCTION MANUAL



MALDEN ELECTRONICS LIMITED

Malden House,
579 Kingston Rd., Raynes Park
London SW20 8SD. ENGLAND.
Telephone 01-543 0077

MP MASTER



MA23604



PULSE GENERATOR

MODEL 738

Instruction Manual

c 1976

WITHOUT OUR PERMISSION THIS DRAWING /
SPECIFICATION / DOCUMENT / REPORT WHICH
IS OUR COPYRIGHT MAY NOT BE REPRODUCED
OR MADE AVAILABLE TO THIRD PARTIES
© 1975

MALDEN ELECTRONICS LIMITED

Malden House,

579 Kingston Road, Raynes Park SW20 8SD, England

Telephone 01-543 0077

Publication Ref. IM738/IZ/jp/11.76/Issue 1

TABLE OF CONTENTS

Section	<u>Page</u>
1 INTRODUCTION	1
2 SPECIFICATION	2
2.1 Power Supply	2
2.2 Pulse Rate	2
2.3 Control Modes	2
2.4 Main Pulse	3
2.5 Pre-Pulse	3
2.6 Temperature Range	3
2.7 Dimensions & Weight	3
3 OPERATION	4
3.1 Mains Voltage Setting	4
3.2 Mains Fuse Rating	5
3.3 Connection of Mains Supply	5
3.4 Connection of Signal Leads and Initial Test	5
3.5 General Instrument Operation	6
3.5.1 Pulse Mode Selector	6
3.5.2 Pre-Pulse Output	6
3.5.3 Clock Mode Selector	6
3.5.3.1 Internal	6
3.5.3.2 Manual (single shot mode)	6
3.5.3.3 External Trigger	7
3.5.3.4 Internal Gated	7
3.5.4 Delay Controls	7
3.5.5 Width Controls	7
3.5.6 Main Pulse Output Controls	7
4 CIRCUIT DESCRIPTION	8
4.1 Diagrams	8
4.2 Supply Circuit	8
4.3 Clock Board (738/1) (E70/78)	9
4.3.1 Clock Generator Timing Elements	9
4.3.2 Pre-Pulse	9
4.3.3 Ext. Trigger	10
4.3.4 Manual Push-Button Trigger Circuit	10
4.3.5 Internal Gated Mode	10
4.4 Width/Delay Board 738/2 (E70/79)	10
4.5 Output Board 1 (Channel, 1) (738/3)	11
4.6 Output Board 2 (Channel 2) (738/4)	11

The Model 738 Pulse Generator is a versatile instrument providing simultaneous positive and negative outputs over the range 1Hz to 10MHz.

Amplitude, Pulse width and delay are each variable independently. As a double pulse generator, both channels can be time-mixed A+B and B+A with independent control over width and delay with a common amplitude on a given channel.

Channel A has provision for +ve and -ve pulse output by switching both channels to mixed pulses and inverting A, two double pulse trains are obtained.

Long-term reliability is achieved by the application of advanced instrumentation techniques combined with the utilization of universal pulse generator integrated circuits and plug-in printed circuit modules. To simplify maintenance the 738 has been designed with no internal adjustments and no recalibration procedures.

The generator is supplied complete with a fold-away tilt-stand and facilities for stowage of the supply cable.

Section 2

SPECIFICATION

2.1 POWER SUPPLY

200-250V, 45-60Hz/400Hz

100-125V, 45-60Hz/400Hz

Consumption 20W

2.2 PULSE RATE (CLOCK)

Frequency Range: 1Hz to 10MHz covered by 7 switched-ranges and uncalibrated vernier control.

2.3 CONTROL MODES

- (1) Internal: Continuous production of pulses at selected rate.
- (2) Internally Gated: Pulses at selected rate produced for duration dependent upon external gated input signal specified in (3) below. Internal clock synchronously controlled by external input. Output pulse-cycle (single or double pulse) present at end of gating period continues until complete.
- (3) External Trigger: Production of pulses triggered by external input signal.
- External input signal:
- Frequency range : D.C. to 2.5MHz
- Input : Triggers between +1V & +2V
- Max. Input : 50V
- Input impedance : 2k Ω , 200pF (approx.)
- Input coupling : D.C.
- (4) Manual: Single pulse-cycle initiated by push-button depression.

1875

1875

1875

1875

1875

1875

1875

1875

1875

1875

1875

2.4

MAIN PULSE

Output modes:

Channel A: Positive or Negative

Channel B: Positive only

Channel mixing: Both channels may be time mixed. A+B and B+A with independent control over pulse width and delay thus providing true double pulse facilities.

Amplitude: Adjustable from approx. 0.5V to 10V

Output impedance: 50Ω

Delay range: 50ns to 1sec., covered by 8 decade ranges with uncalibrated vernier.

Pulse width range: 50ns to 1 sec., covered by 8 decade ranges with uncalibrated vernier.

Protection: Output short circuit and open circuit protected.

Rise and fall times: Less than 10ns

2.5

PRE-PULSE

Polarity: Positive

Amplitude: 2V approximately (50Ω terminated)

Output impedance: 50Ω

2.6

TEMPERATURE RANGE

-10° to +55° Centigrade

2.7

SIZE AND WEIGHT

Width: 216mm

Height: 89mm

Depth: 290mm (case)
310mm (overall)

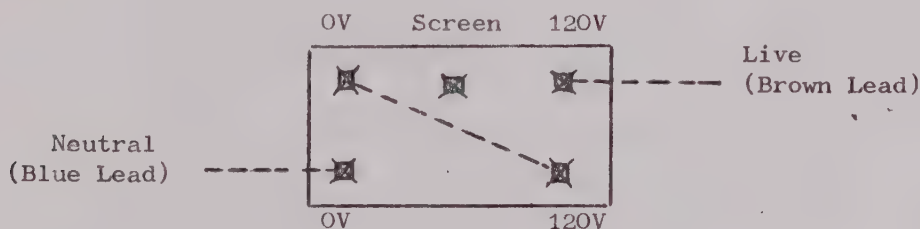
Weight: 3kg.

3.1 MAINS VOLTAGE SETTING

Before connecting a mains supply to the instrument check that the two primary windings of the internal transformer are appropriately connected for the supply voltage; proceed as follows.

Remove the upper section of the case after withdrawing its four fixing screws (two at either side).

The transformer is mounted next to the instrument rear panel. Terminations at the primary tags, which face rear panel of the instrument (viewed from front panel), are shown below. Note. Tags are represented by X's.



The primary windings should be linked in series or parallel according to the supply voltage. The appropriate links, which should be made by soldered wires, are as follows.

200-250V A.C. Supply

Winding series connected. The 120V and OV tags as shown above should be linked together.

100-125V A.C. Supply

Windings parallel connection. The two OV tags should be linked together (Neutral termination) and the two 120V tags should be linked together (Live termination).

Refit and secure the upper section of the case.

3.2 MAINS FUSE RATING

Check that the mains fuse, mounted above the cable entry at the rear of the instrument, is suitable for the supply voltage; fuse ratings are as follows.

<u>Supply Voltage</u>	<u>Fuse Rating</u>
100-125V a.c.	600mA Slow Blow
200-250V a.c.	300mA Slow Blow

3.3 CONNECTION OF MAINS SUPPLY

Having checked the voltage-setting (Section 3.1) and the fuse rating (Section 3.2) connect the three-core mains cable to the supply thus:

Brown core	:	LIVE
Blue core	:	NEUTRAL
Green and Yellow core	:	EARTH

3.4 CONNECTION OF SIGNAL LEAD AND INITIAL TEST

The front panel-mounted coaxial sockets are of the BNC type. It is recommended that after transit and prior to general use of the instrument, a test be made to check its basic operations.

To conduct the test, connect a coaxial cable at output socket A or B channel and connect one beam of a double-beam oscilloscope so as to observe the signals developed. Connect the second beam to the 'Pre-Pulse' socket (terminate in 50 Ω). Use Pre-Pulse to trigger the oscilloscope INTERNALLY with +ve slope.

Set the Power switch to 'ON' (the red 'Power On' neon indicator should light-up) and set the controls as indicated below:

<u>Control</u>		<u>Setting</u>
Period	switch	: 10msec.
	vernier control	: MIN. position
Delay A & B	switch	: 1ms
	vernier control	: MIN. position
Width	switch	: 1msec.
	vernier control	: MIN. position
Amplitude	vernier control	: 10V
Toggle	switch	: Normal '+', 'A & 'B' positions
EXT/INT	toggle switch at rear	: 'INT'

Check that the positive pulse from channel A or channel B output, each has a width $\leq 1\text{msec}$ spaced $\leq 1\text{ms}$, apart (i.e. between leading-edges) are produced after each pre-pulse.

3.5 GENERAL INSTRUMENT OPERATION

3.5.1 Pulse Mode Selector

CHANNEL A: Positive or negative 'Main Pulse/s' selected by two position toggle switch marked '+' and '-'. On channel A, channel B can be mixed by selecting toggle switch A+B.

CHANNEL B: Positive 'Main Pulse/s' and may be mixed with channel A by selecting toggle switch B+A.

For single 'Main Pulse' output the delay time (set by the DELAY CONTROL) is the duration between the leading-edge of 'PRE-PULSE' and the leading edge of the 'Main Pulse' output.

The width, delay and amplitude of each channel can be controlled independently by their control knobs, and vernier knobs.

For double pulse output (when both channels are time-mixed A+B or B+A) the width and delay control independently on each pulse with a common amplitude.

3.5.2 Pre-Pulse Output

A coaxial socket marked 'PRE-PULSE' is provided for positive 2V pulse (terminated into 50 Ω).

3.5.3 Clock Mode Selector

3.5.3.1 Internal

With INT/EXT toggle switch (at rear panel) selected to 'INT' position, the Internal clock is enabled. The PERIOD selector rotary switch is covered by 7 decade ranges of repetition frequency from 10MHz to 1Hz and for each range the fine control serves as a variable frequency control.

3.5.3.2 Manual (single shot mode)

With 'INT/EXT' toggle switch (at rear panel) to 'EXT' position and 'PERIOD' rotary switch to 'EXT' position, the instrument is triggered to produce one pulse cycle each time the 'MANUAL' push button is depressed.

3.5.3.3 External Trigger

With 'INT/EXT' toggle switch (at rear panel) to 'EXT' position and 'PERIOD' rotary switch to 'EXT' position, the instrument is triggered by signals applied to the socket at the rear panel designated 'TRIGGER'.

3.5.3.4 Internal Gated

With 'INT/EXT' toggle switch (at rear panel) to 'EXT' position, the internal clock (selected by PERIOD rotary switch) can be 'enabled' by a suitable external signal applied to the EXT 'GATE INPUT' socket at the rear panel.

The 'enabled' period is the duration for which the amplitude of the external signal exceeds trigger level, and is the duration for which output pulses are generated.

In this mode of operation (for single or double pulse output) the output pulse cycle present at the end of gating period continues until complete.

3.5.4 Delay Controls

Independent delay controls are incorporated to set the delay in Channel A and Channel B. The time between the 'Pre-pulse' and the 'main pulse' is extended by the amount set by the DELAY control.

3.5.5 Width Controls

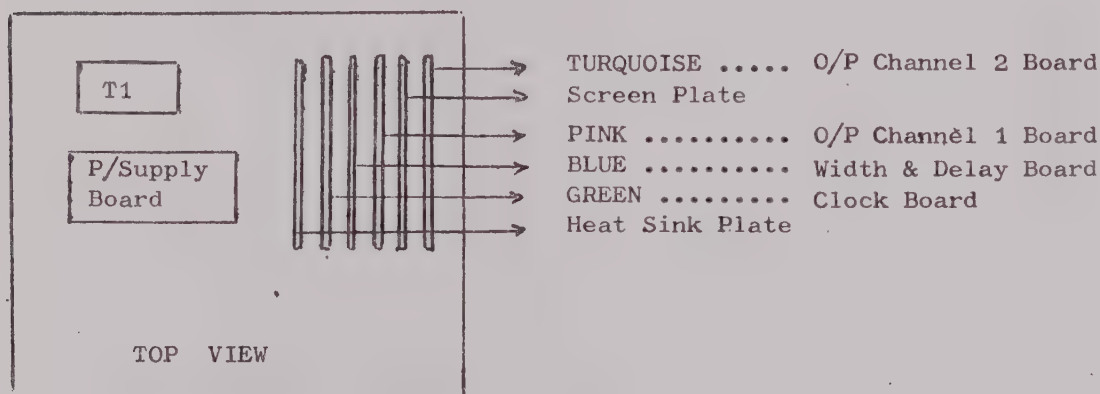
The setting of these controls indicate the duration of each 'main pulse'. These controls are physically identical to, and may be set in the same manner as, DELAY controls.

3.5.6 Main Pulse Output Controls

Two channels are provided for the 'Main' output pulse/s. Each channel comprises an output level control, and coaxial sockets marked 'CHANNEL A' and 'CHANNEL B': the setting of an adjacent toggle switch determines single channel or mixed channel operation. Channel A is also provided with an extra toggle switch marked '+' and '-' to provide a positive or negative pulse output. By mixing channels A+B and B+A, both channels may be time mixed with independent control over pulse width and delay; thus providing true double pulse facilities.

4.1 DIAGRAMS

Diagram E70/83 shows the main circuit arrangement of the instrument in semi-block schematic form. Each block represents a printed circuit module and contains the type number and title applicable to the module. Numbers prefixed by the letter E are the circuit diagram numbers of the individual modules. The physical positions of the modules are indicated on the layout diagram below:



4.2 SUPPLY CIRCUIT

The supply is received at the three-cored cable, depicted near the top left hand corner of diagram E70/83, and is fed via fuse FS1* and double-pole POWER switch S9 to the POWER ON indicator lamp circuit (LP1/R1, mounted on POWER SUPPLY BOARD type 738/5), T1 transformer and POWER SUPPLY module type 738/5.

The supply is received at transformer T1, the two 125V primary windings of which should have been appropriately connected to suit the input voltage: series connected for 200-250V a.c. or parallel connected for 100-125V a.c. (for transformer connection refer to Section 3.1).

Within the POWER SUPPLY module (Drg. E70/82), the two secondary windings of T1, 15V a.c. is supplied to full-wave rectifier bridges D1 and D2, and smoothing capacitors C1 and C2. The positive +12V stabilized d.c. voltage is derived from TR1 voltage regulator. The output of TR1 is also connected to TR2 voltage regulator to derive +5V stabilized d.c. voltage.

* For fuse rating refer to Section 3.2.

The output of D2 bridge rectifier is fed to negative voltage regulator to obtain -12V stabilized d.c. voltage.

The output supply lines, +12V, +5V, -12V and 0V are supplied to the CLOCK, WIDTH/DELAY, and output CHANNEL 1/2 boards.

4.3 CLOCK BOARD 738/1 (E70/78)

4.3.1 Clock Generator Timing Elements

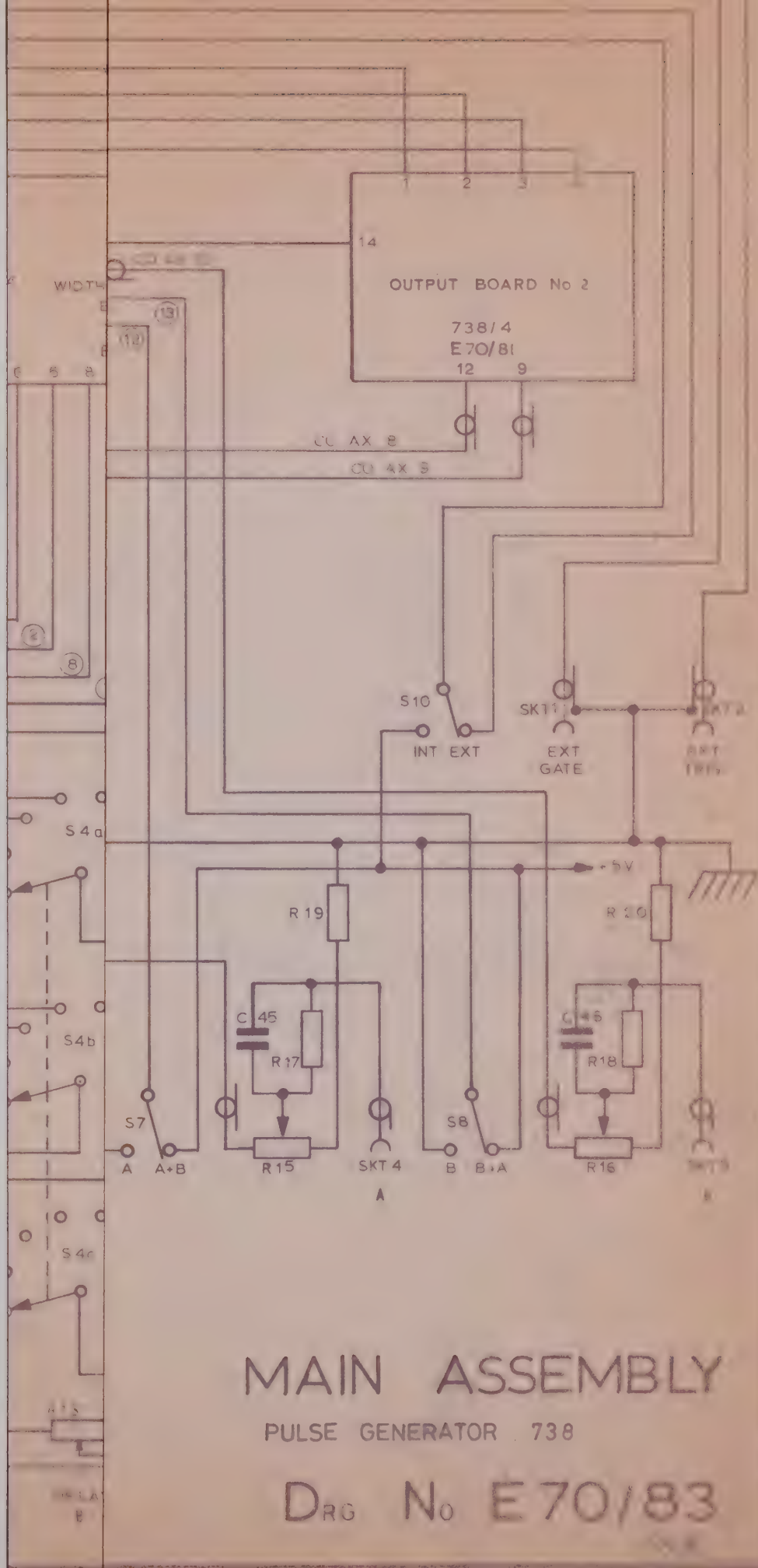
The Rate Generator timing element comprises cascade-connected monostables Integrated circuit X1. The period of the timing element is dependent upon:

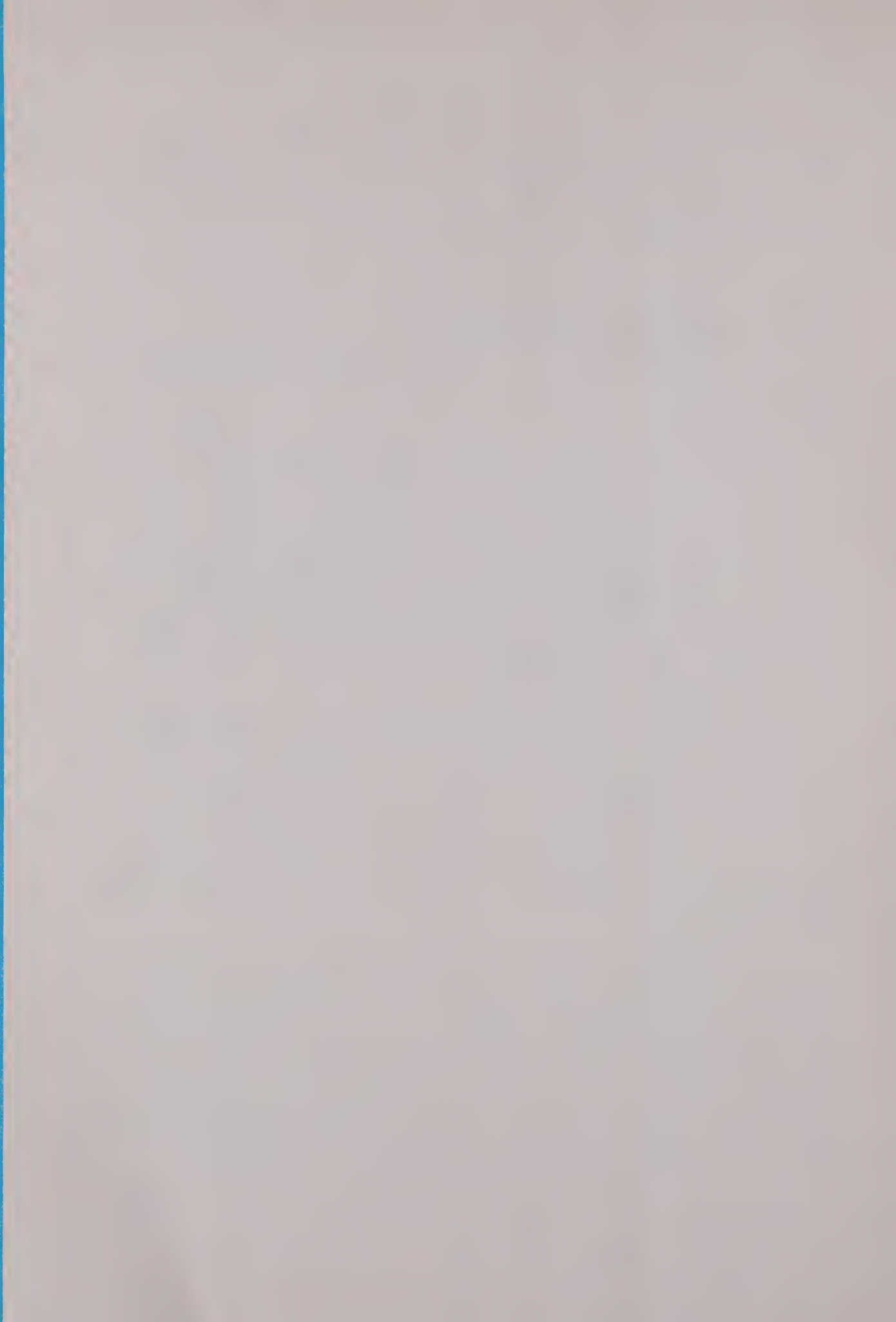
- (i) The setting of the PERIOD switch (S1 Drg. No. E70/83) which connects one of the capacitors of group C1 to C7 across one of the monostables, and simultaneously connects a capacitor of group C8 to C14 across the other monostable of the Integrated circuit X1. When the inhibit oscillator i/p (selected by toggle switch S10 INT/EXT) Pin 15 is taken to logic 1(+5V); i.e. switch selected to INT., the feedback path is operative within I.C.X1 and hence I.C.X1 remains in Oscillation Mode.
- (ii) The setting of PERIOD vernier control (Drg. No. E70/83) R10, and fixed resistor R9 determine the magnitude of charging current in the capacitor C1-C7. The capacitors group C1 to C7 provides a control of frequency in decade steps and vernier control determines the fine frequency control.

An output from the timing circuit is obtained from Pin 10 of X1 and applied to 'WIDTH DELAY CCT'. via switch S1e, edge connector Pin 5(& 3).

4.3.2 Pre-Pulse

The positive timing pulse arriving at edge connector Pin 5(& 3) is inverted by gate X2 (Pins 1,2,3). A -ve output pulse from Pin 3 of X2 switches on TR3, amplifier/50 Ω impedance converter. A positive pulse of approximately 2V, with 50 Ω termination, is fed to output socket at the front of the instrument. The capacitor C6 is provided to delay the line to compensate for differences in Main pulse and Pre-pulse transmission times, by delaying the pre-pulse sufficiently to ensure the correct time relationship between the main pulse & pre-pulse at their respective output sockets.





4.3.3 Ext. Trigger

By selecting PERIOD switch to 'EXT' position, and 'INT/EXT' switch at rear panel to 'EXT', the Ext. trigger circuit (TR2: X2 pins 8,9,10) output at Pin 7 of edge connector is connected to 'WIDTH DELAY CCT. Board' via rotary switch S1e (Drg. E70/83). The positive signal applied to the 'EXTERNAL' socket at the rear causes TR2 to conduct, which in turn, causes the output of gate X2 pin 8 to go high, which the leading edge then triggers 'WIDTH DELAY CCT' and 'PRE-PULSE' circuit, X2 (Pins 1,2,3) and transistor TR3.

4.3.4 Manual Push-Button Trigger Circuit

When 'PERIOD' switch to set to 'EXT' position the depression of 'MANUAL' push button switch causes X2 input, pin 9, to go low (to OV). The positive pulse at X2 output, pin 8 triggers the 'WIDTH DELAY CIRCUIT' and 'PRE-PULSE' circuit, X2 pins (1,2,3) and TR3 transistor.

4.3.5 Internal Gated Mode

With 'INT/EXT' toggle switch selected (at rear) to 'EXT' position, the internal clock (selected by 'PERIOD' rotary switch) can be 'enabled' by applying Positive signal at 'EXT GATED INPUT' socket at the rear panel. The signal applied passed through limiter/amplifier, TR1 and inverter gate X2 (Pins 4,5,6), EXT/INT switch, to I.C. X1 pin 15 of edge connector. When external signal is low, pin 8 of X10 is held low and hence, the oscillator is inhibited. When the external signal exceeds trigger level, the oscillator is 'enabled'. For single or double pulse output, the output pulse cycle, at sockets A or B, is produced for duration dependent upon the external signal. The output cycle present at the end of the gating period continues until complete.

4.4 WIDTH/DELAY BOARD 738/2 (Drg. E70/79)

The positive pulse from 'CLOCK Board' pin 3 is applied to pin 4 of 'WIDTH DELAY Board'. The leading edge triggers pin 5 of twin monostable integrated circuit X1 and X2. The first monostable of X1 and X2 introduces delay before the main pulse appears. This delay can be varied by altering the monostable time constant. For DELAY A the time constants are C15-C21 (mounted on rotary switch S2 a,b) and resistor R1, R2 and variable potentiometer control R11. For DELAY B, the time constants are C22-C28 (mounted on rotary switch S4 a,b) and resistor R5,6 and variable potentiometer R13.

When first monostable of X1 and X2 resets, it triggers second monostable in I.C. X1 and X2 that produces the main pulse. The width of the main pulse A from X1 and pulse B from X2 may be varied by altering the second monostable time constants; for width A time constant components are C29-C36 (mounted on rotary switch S3 a,b) and resistors R3, R4 and variable potentiometer R12. For width B time constant components are C37-C44 (mounted on rotary switch S5 a,b) and resistors R7,R8 and variable potentiometer R14. The main pulse A, non-inverted and inverted appear at pin 9 and pin 10 of 738/2 boards from I.C. X1; and main pulses B, non-inverted and inverted appear at pin 15 and pin 16 of 738/2.

4.5 OUTPUT BOARD 1 (CHANNEL 1) (738/3)

With toggle switch S7 set to A, 0V potential is applied to pin 9 of X1. Hence gates (8,9,10) are inhibited, therefore pin 8 of X1 is held at logic 1. Thus -ve A, main pulse at pin 2 of X1 is allowed. The positive main A pulse appears at pin 3 of X1. When S7 is set to A+B, +5V potential is applied to pin 9 of X1. Hence main B pulse is allowed through gate o/p pin 8. Thus simultaneously A and B main pulses are fed at pin 2 and 1 of X1. Therefore at pin 3 of X1, A+B main pulse appears. The main pulse A or A+B is passed to pin 14 of Output Board 738/3.

Similarly by selecting toggle switch S8 at position B or B+A, gates (4,5,6) and (11,12,13) select main pulse B or B+A. The +ve main output pulse from pin 11 of X1 is fed to TR1, TR2, two inverting transistor/amplifier stages and parallel connected TR3-TR5 output buffer transistors. The main output pulse B or B+A from pin 5 of 738/3 board is taken via wiper of R16 potentiometer (amplitude) control to output socket 5.

4.6 OUTPUT BOARD 2 (CHANNEL 2) (738/4)

The Positive main pulse A or A+B is taken to pin 14 of 'Output Board 2', 738/4; and fed to two Inverting/Amplifier transistors TR1 and TR2 stages and parallel connected output buffers TR3-TR5. The positive main pulse appears at pin 12 of 738/4 board.

The positive main pulse at TR2 collector is also fed to the base of normally ON transistor TR6. The positive pulse switches TR6 OFF and therefore negative (from 0V to -12V swing) pulse appears at TR6 collector which in turn is fed to parallel connected output buffer transistor TR7-TR9.

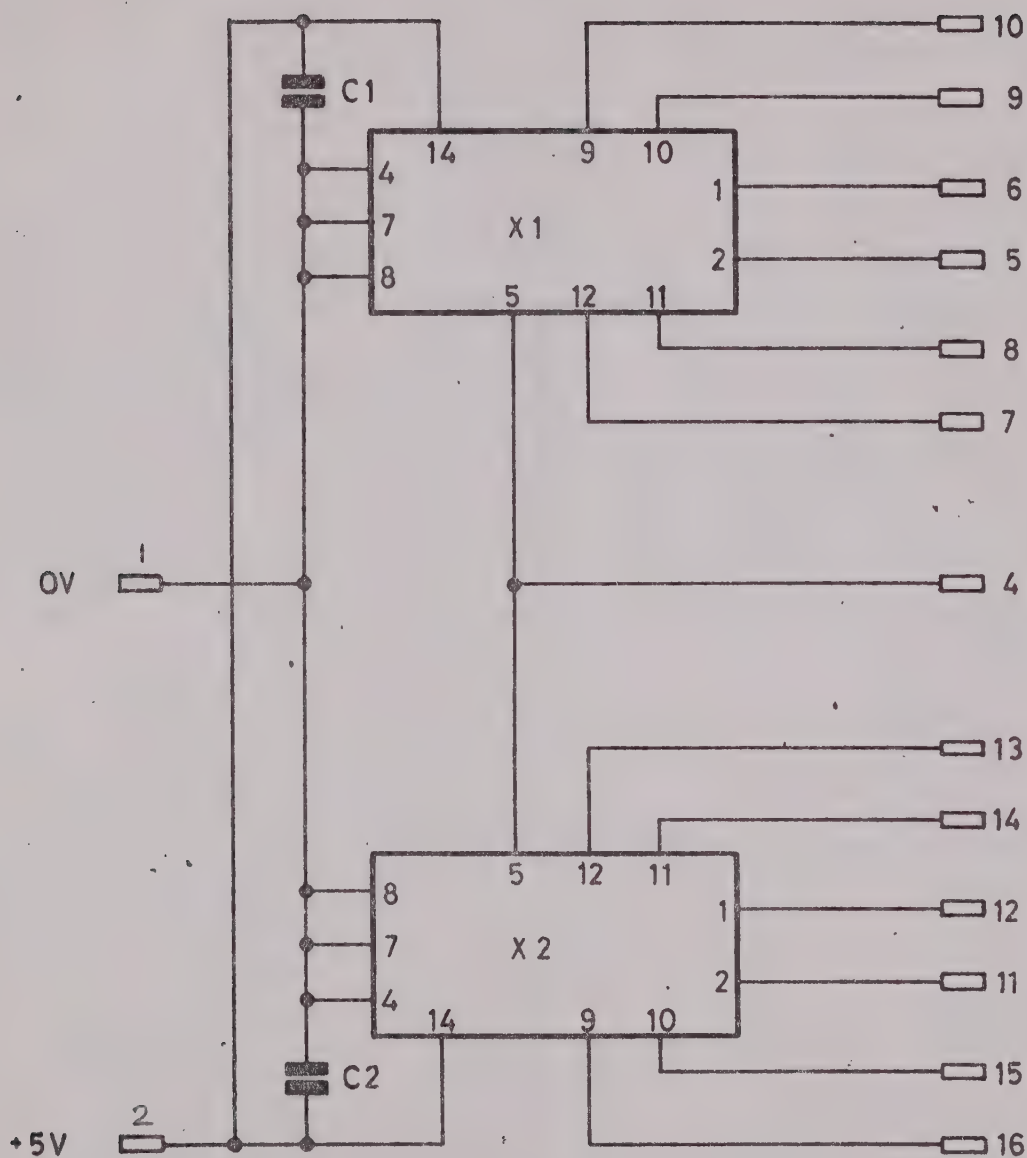
Hence negative main pulse A or A+B appears at pin 9 of 738/4 board.

The positive and negative main pulse/s at pin 12 and pin 9 respectively from 738/4 board is connected to toggle switch, S6 which may be set to select '+' or '-' pulse/s. The pulses routed via S6 is then fed to potentiometer (amplitude) control R15 to output socket 4.



TYPE 738/1

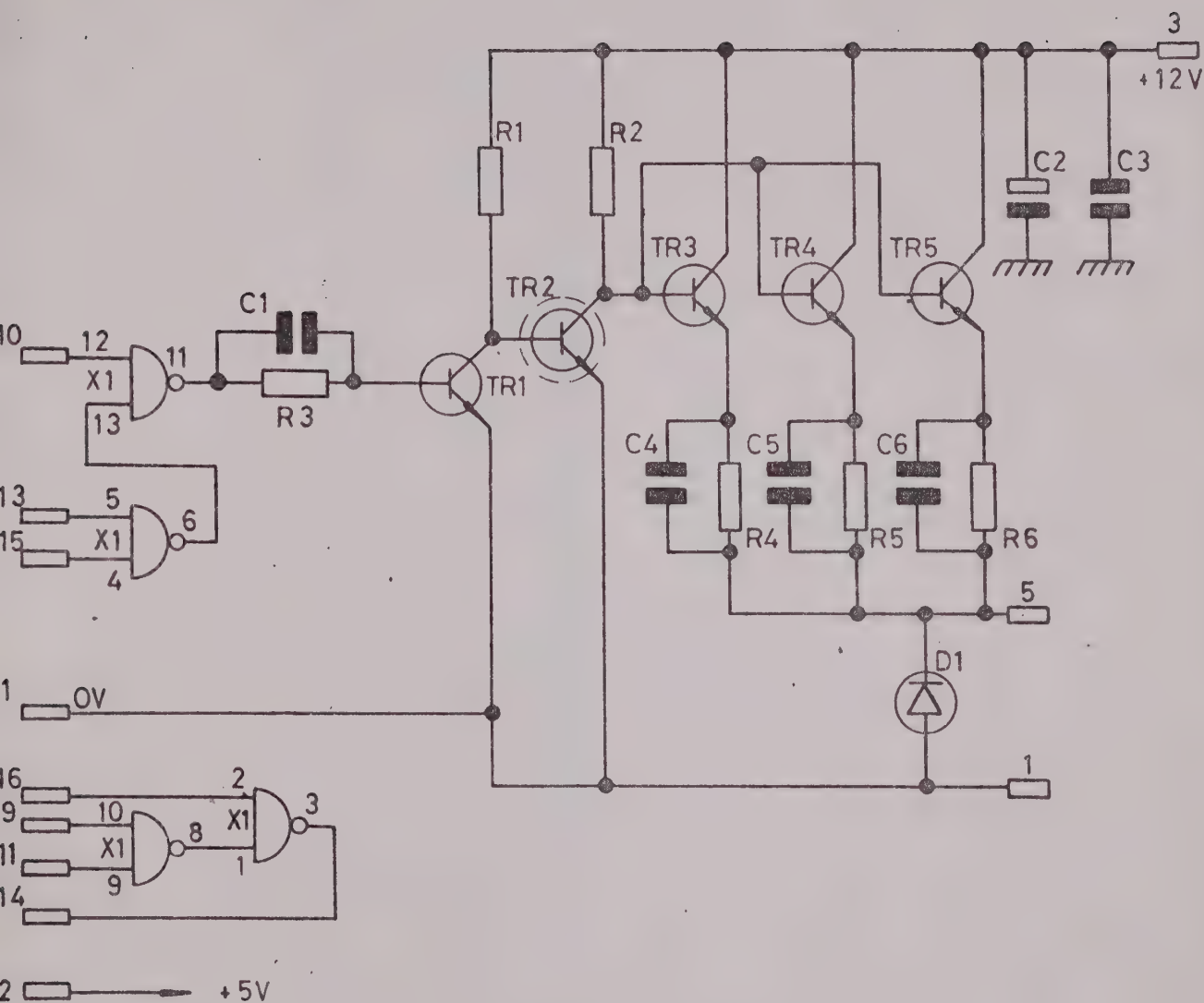
D_{RG.} N_C E70/78



WIDTH DELAY CIRCUIT

TYPE 738/2

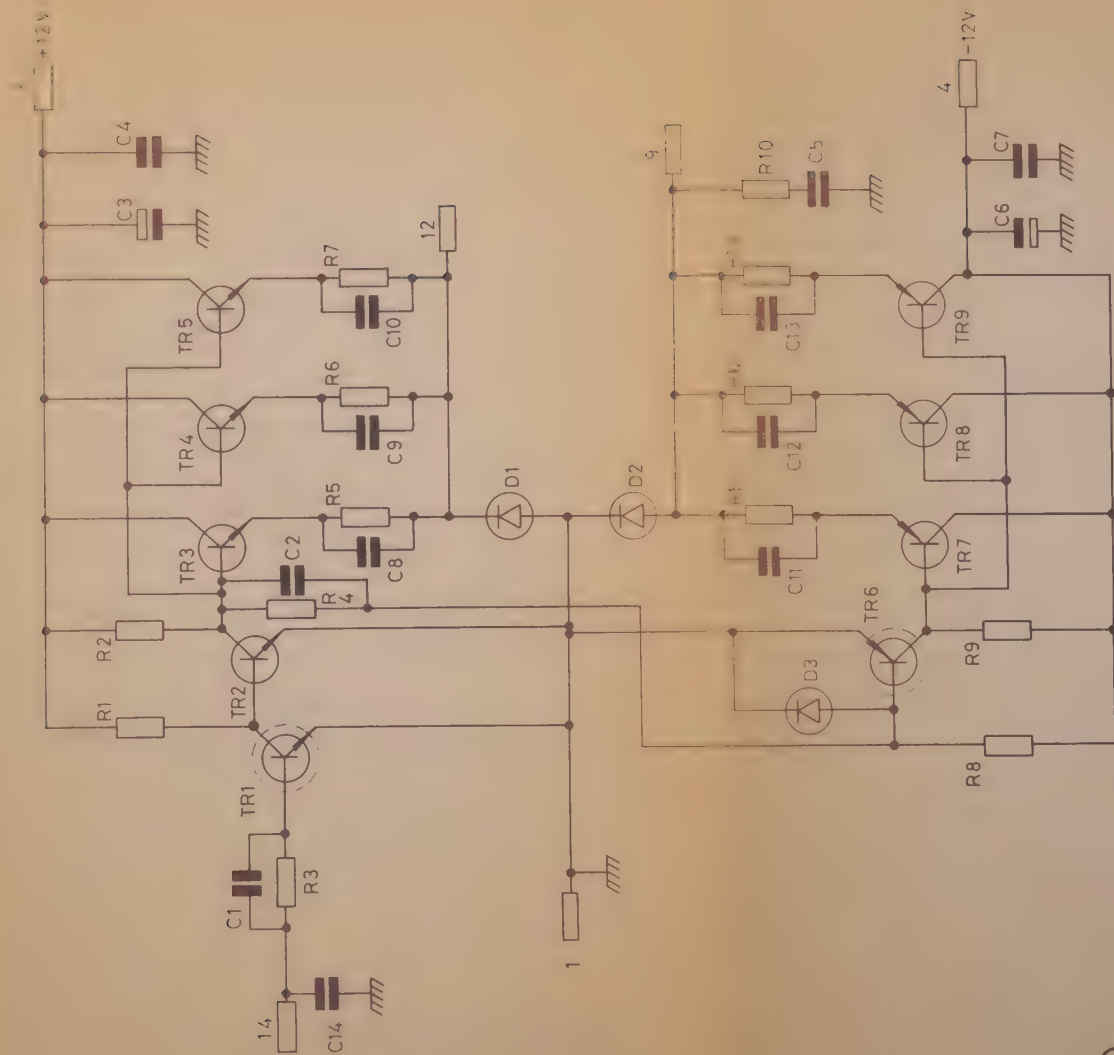
DRG. No. E70/79 ISSUE



OUTPUT CHANNEL No.1

TYPE 738/3

DRG. No. E70/80 ISSUE

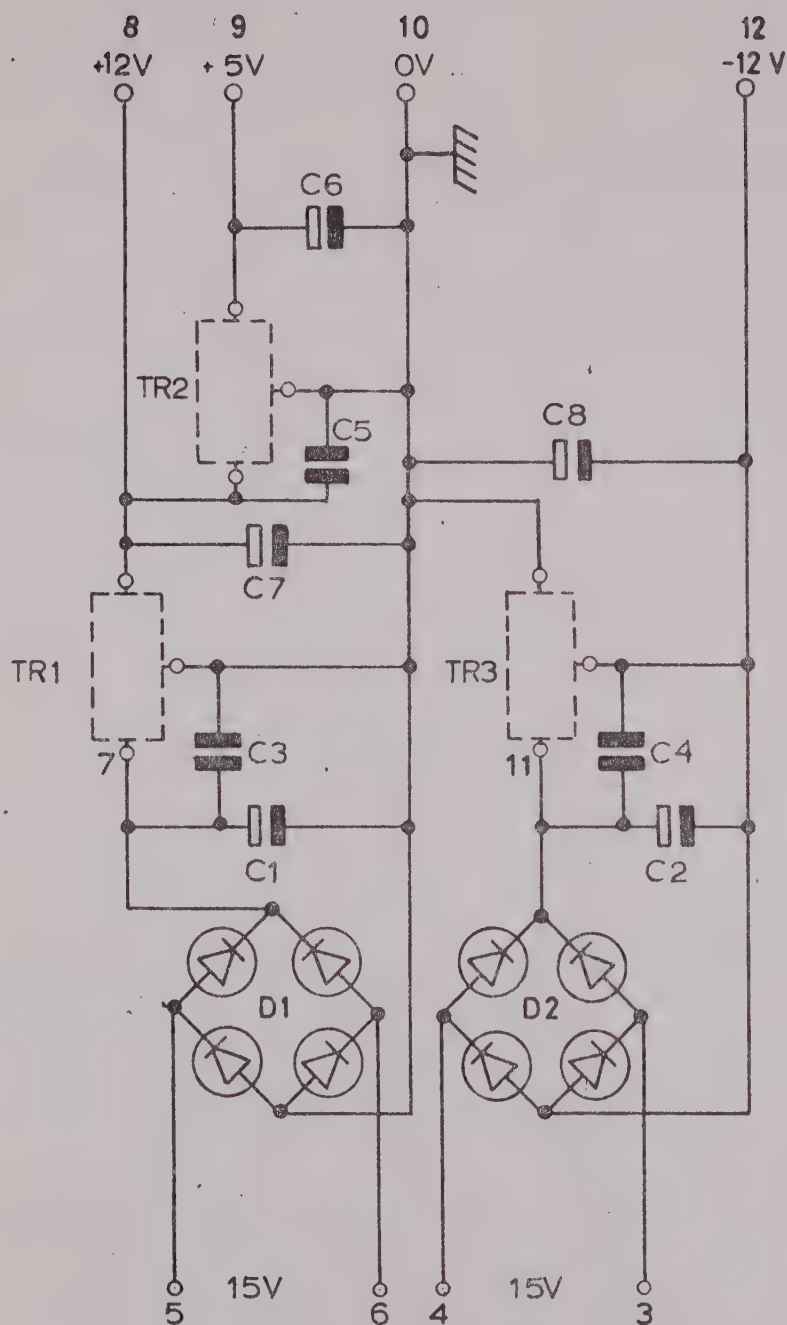


OUTPUT CHANNEL No 2

TYPE 738/4

D_{RG} N₀. E70/81

ISSUE



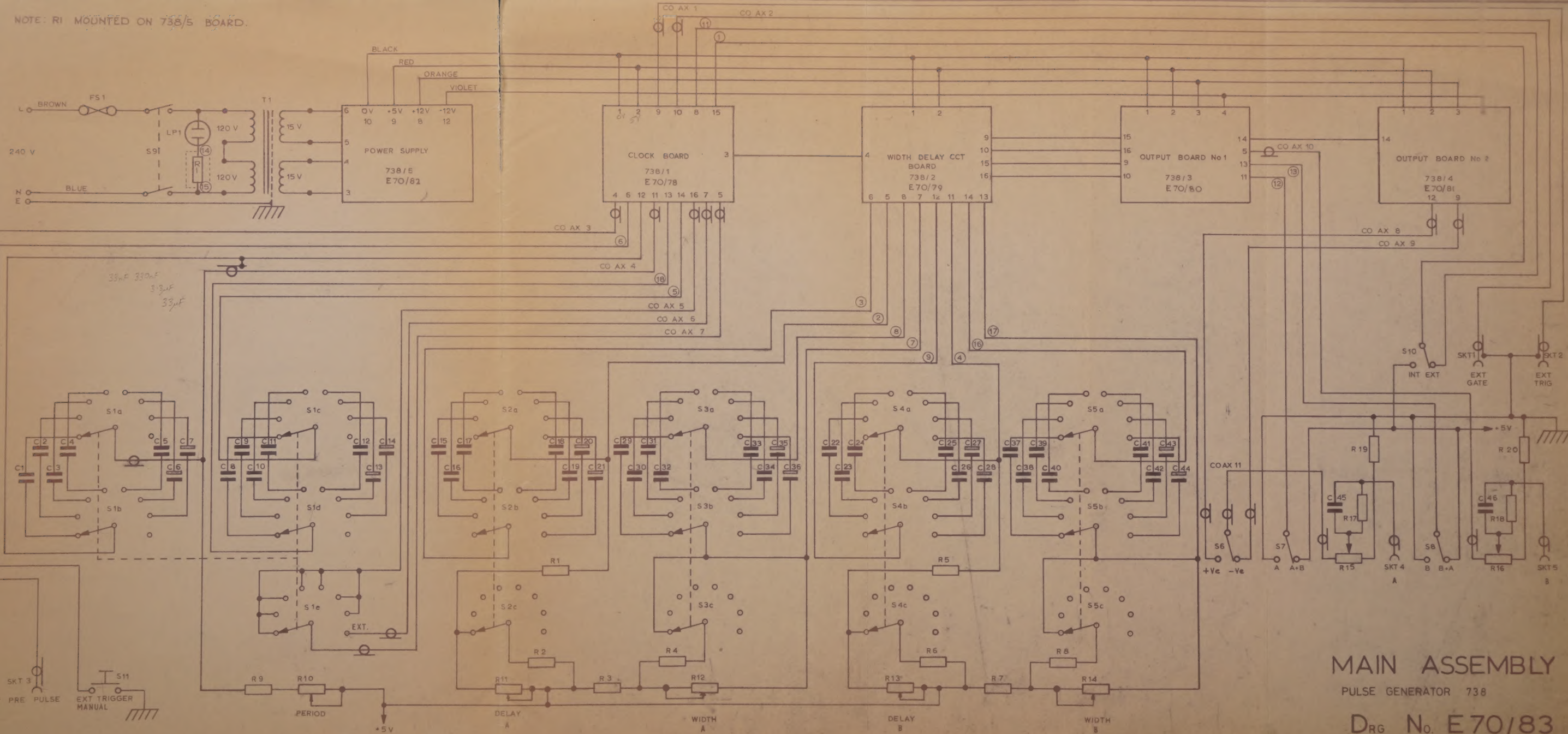
ITEMS SHOWN IN DOTTED
DETAIL MOUNTED ON
HEAT SINK

POWER SUPPLY

TYPE 738/5

DRG. No. E70/82 ISSUE

NOTE: R1 MOUNTED ON 738/5 BOARD.

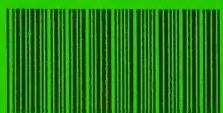


MAIN ASSEMBLY
PULSE GENERATOR 738

DRG No. E70/83

ISSUE

MP MASTER



MA23604